Optics Working Group update

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X-ray Surveyor Face-to-Face
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Outline

- Optics Working Group (OWG) update
- OWG plans
- RFI and industrial engagement

OWG

- Mission statement

  The OWG is helping the STDT prepare the Telescope Road Map, that will be delivered to the Decadal Survey, to develop the technologies and techniques needed to build the telescope required for Lynx to meet its science objectives

- Leadership
  - Mike Pivovaroff (LLNL), chair + STDT member
  - Lester Cohen (SAO), co-chair + Study Team member
  - Mark Schattenburg (MIT), co-chair + community member

- 37 members and counting
  - X-ray astronomers (mostly)
    - Majority from U.S. institutions, but Europe represented as well
  - X-ray optics experts from U.S. light-sources

- Industry
  - Working on it! (more in two charts)

OWG (2)

- Sub-groups (TBC)
  - Full-shell substrates
  - Segmented substrates
  - Post-manufacture figure correction
  - Mirror metrology
  - Systems & system engineering
  - Coatings, w.r.t Effective Area optimization

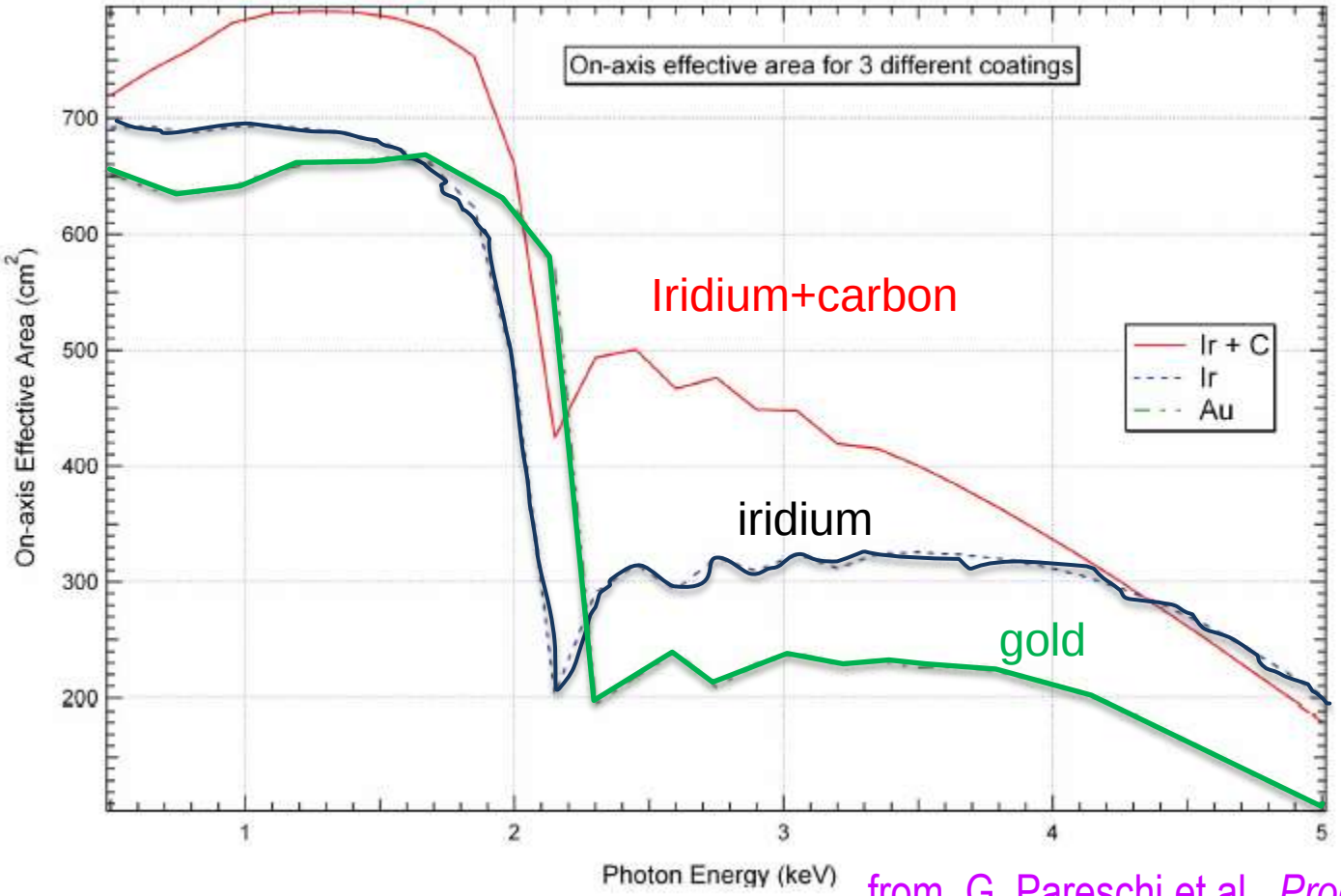
- Monthly meetings, to start
  - Cadence will likely increase, once we have specific actions on which to engage the OWG
  - Need to start coordination with IWG

The sooner we have hard targets, the sooner we can unleash the horsepower in the OWG

  - E.g., while keeping 1.5 m^2 at 1 keV, get me as much area from 5-7 keV
  - E.g., if you give up 10% of the area at 6 keV, get me as much area at 1 keV

OWG can study…
tuning effective area versus energy

- An example: over-coating of carbon
  (ATHENA is doing this with B_4C over iridium)



from, G. Pareschi et al. *Proc. SPIE* 5488:418 (2004)

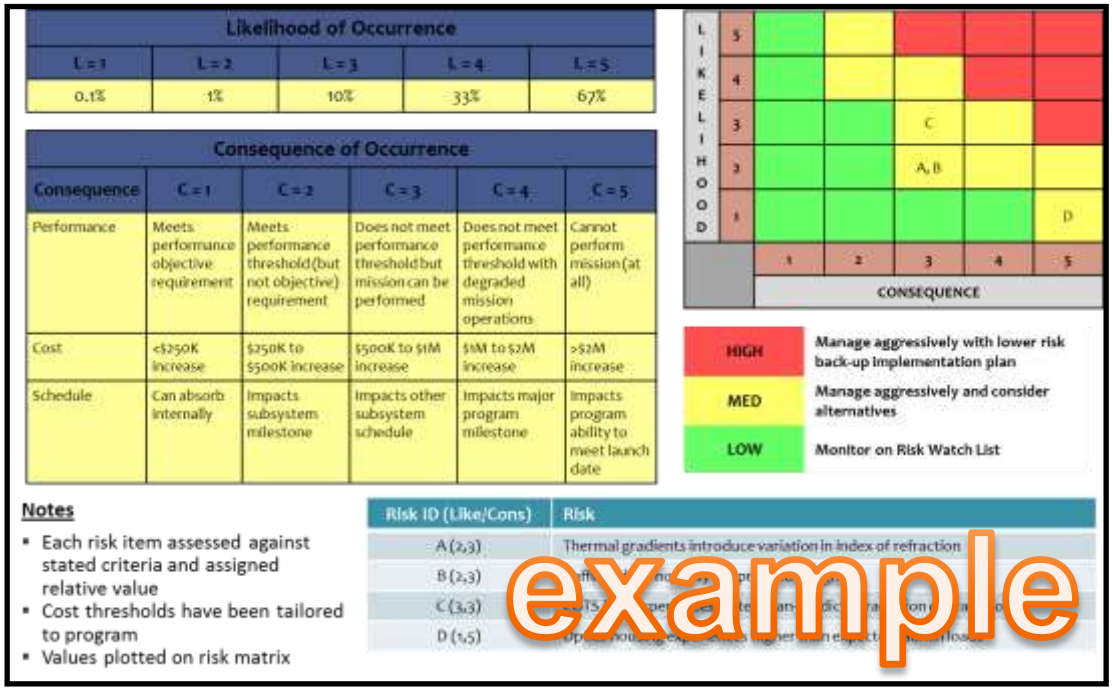
Industry engagement plan

- Plan an Industry Day for Lynx optics (early 2017)
  - Coordinate with other Surveyors to maximize participation from traditional optics shops (Ball, L3, United Technologies, Harris)
    - One day of overlap
  - Use a new RFI to entice
    - X-ray optic companies (e.g,. InSync, RXO, QED, AOA/Xinetics)
    - Silicon processors (e.g., KLA Tencor)
    - Defense contractors (e.g., NG, Raytheon, LM, Boeing, GD)
    - Robotics/automation providers (TBD)

- Communicate our needs and the opportunity: the "frame" matters
  - Good: help build the next NASA flagship; showcase your companies expertise; utilize existing capabilities for a new application
  - Bad: it's really hard; we don't have money; the other Surveyors already have industrial partners

Big picture for the OWG: the Roadmap

- Lots of great information from the Oct'16 Pause and Learn
  - How many point designs to carry?
    - HABEX doing two point designs (4m and 6.5m)
    - Maybe we should do a minimum case (0.5") and a better case (0.2")?
  - We get help from Aerospace! (from their charts)
    - "Focus on trade studies for a baseline concept design"
    - "Support the tailoring of the CML4 for each study team"
  - Be prepared for CATE:
    - "monetizing risk"
    - formalized technical risk process
    - The more people with aerospace/contractor experience, the better



Likelihood of Occurrence

L=1	L=2	L=3	L=4	L=5
0.1%	1%	10%	33%	67%

Consequence of Occurrence

Consequence	C=1	C=2	C=3	C=4	C=5
Performance	Meets performance objective requirement	Meets performance threshold (but not objective) requirement	Does not meet performance threshold but mission can be performed	Does not meet performance threshold with degraded mission operations	Cannot perform mission (at all)
Cost	<$250K increase	$250K to $500K increase	$500K to $1M increase	$1M to $2M increase	>$2M increase
Schedule	Can absorb internally	Impacts subsystem milestone	Impacts other subsystem schedule	Impacts major program milestone	Impacts program ability to meet launch date

HIGH	Manage aggressively with lower risk back-up implementation plan
MED	Manage aggressively and consider alternatives
LOW	Monitor on Risk Watch List

Notes

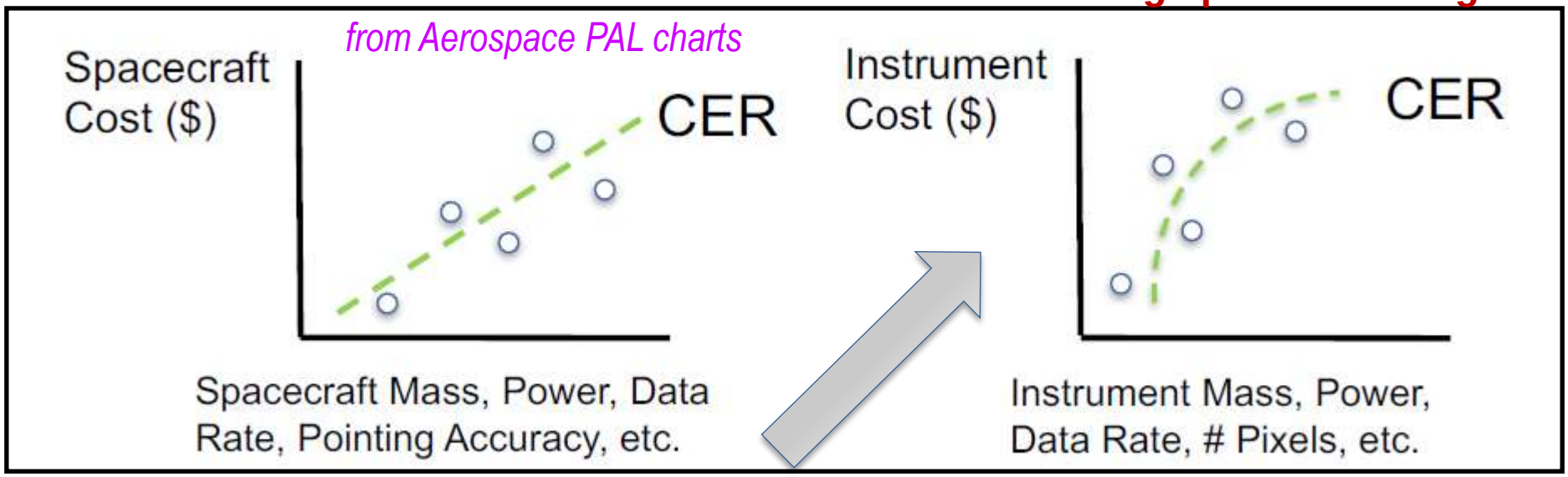
- Each risk item assessed against stated criteria and assigned relative value
- Cost thresholds have been tailored to program
- Values plotted on risk matrix

Risk ID (Like/Cons)	Risk
A (2,3)	Thermal gradients introduce variation in index of refraction
B (2,3)	
C (3,3)	
D (1,5)	

example

Final thought: are we challenging ourselves enough?

Small change in $ yields large performance gain



- This ***notional*** chart captures my personal view: assembling several tens of square meters of thousands of substrates into a sub-arcsecond telescope will be really, really hard but possible. Going from 0.5" to 0.2" does not necessarily have to be harder (= more expensive), than just getting to 0.5" in the first place.

"Mustn't be afraid to dream a little bigger, darling"
-Eames, from *Inception*